Technology transfer and mitigation of climate change: The fertilizer industry perspective

IFA workshop on energy efficiency and CO_2 reduction
Ho Chi Minh, Vietnam 13 March 2007

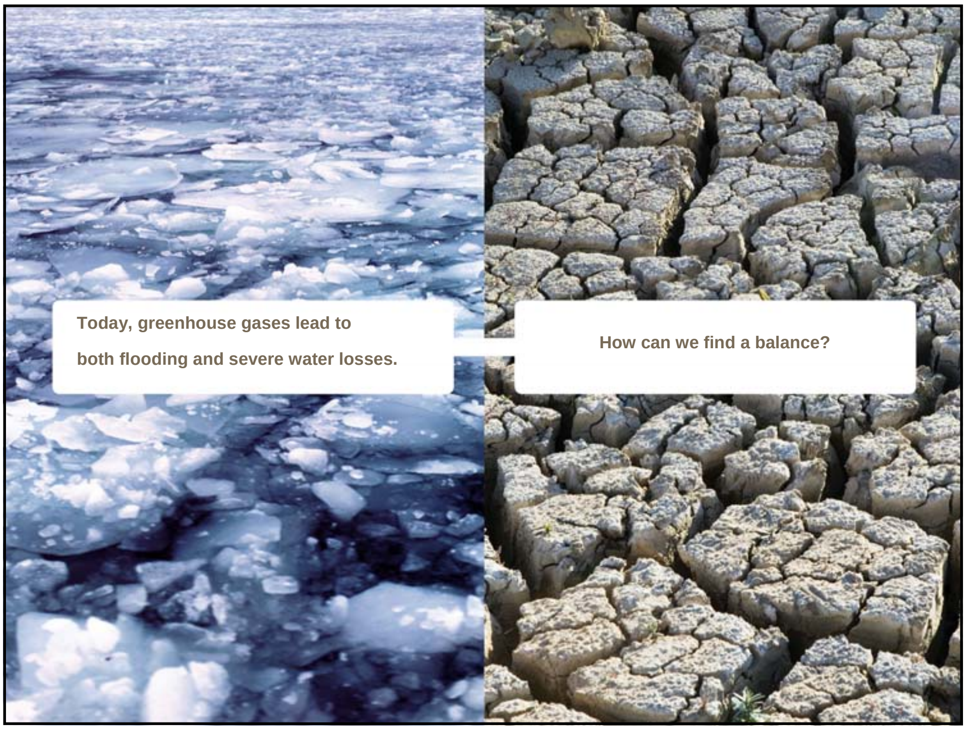
Tore K. Jenssen, Yara International

Thanks

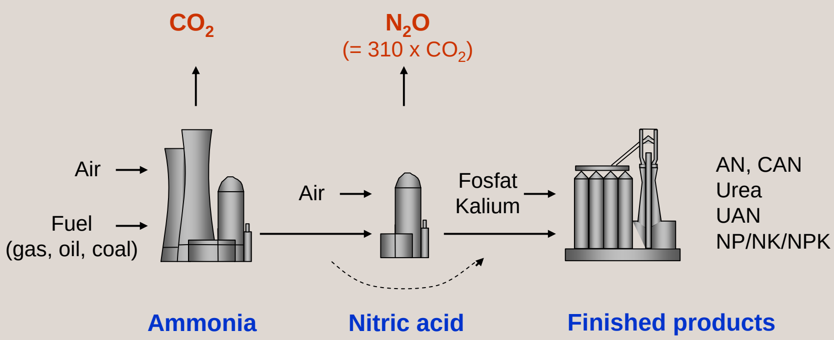
Many thanks to:

- Bhanu Swaminathan of the Fertilizer Association of India
- Kristen Sukalac of IFA

IPCC Expert Meeting Sept 2004:
"Technology Transfer and Mitigation of Climate Change"



Climate change is society's biggest challenge, also for us in the fertilizer industry



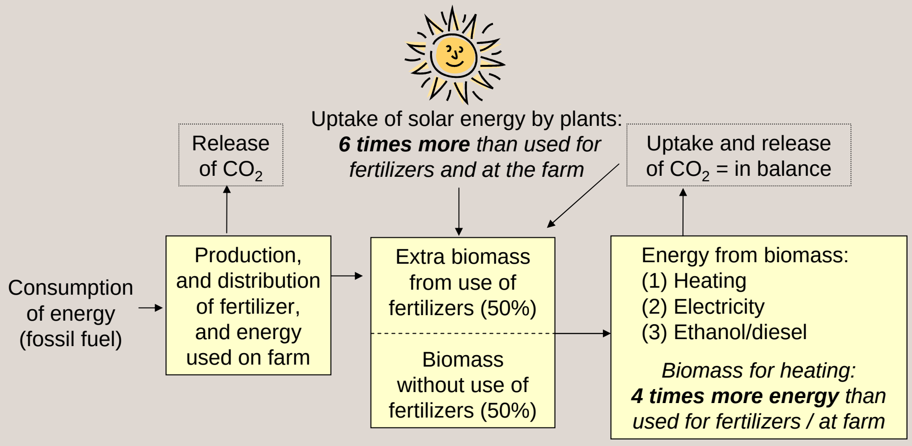
CO_2 emissions are related to energy consumption and type of feedstock

- The fertilizer industry consumes 1-2% of the world's energy
- 80% of the energy is used for ammonia production
- Different feedstock: Natural gas – Oil – Coal
- Driver for improvement: Energy cost and energy efficiency

N_2O emissions are process-related

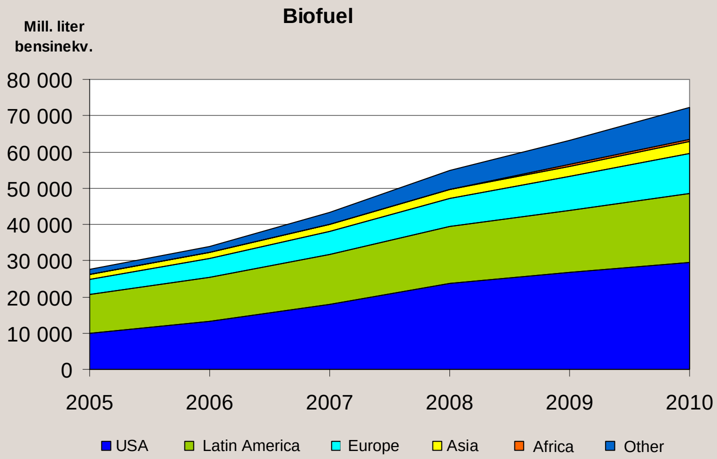
- Significant emissions from nitric acid producers – 100 plants in Europe with emission of 40 mill t CO_2-eqv, worldwide 75 million t CO_2-eqv
- Reduction technology is available, 70-90% reduction is possible, at low cost
- Driver for improvement: Permit regulations

The fertilizer industry in a wider perspective



Compared to use of fossil fuel:
4 times less CO_2 emission

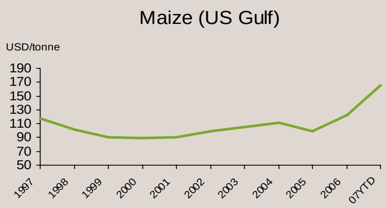
Strong growth in biofuel for energy security

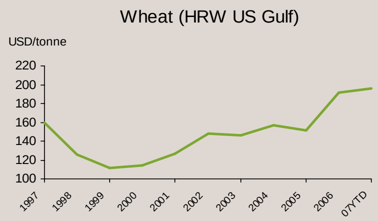


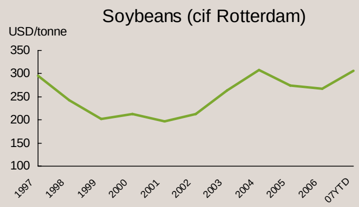
MMboe/day	2005	2006	2007	2008	2009	2010
Biofuel	*0,41*	*0,51*	*0,65*	*0,83*	*0,95*	*1,09*

Kilde: Pira February 2007 of Yara

10-year grain/oilseed prices

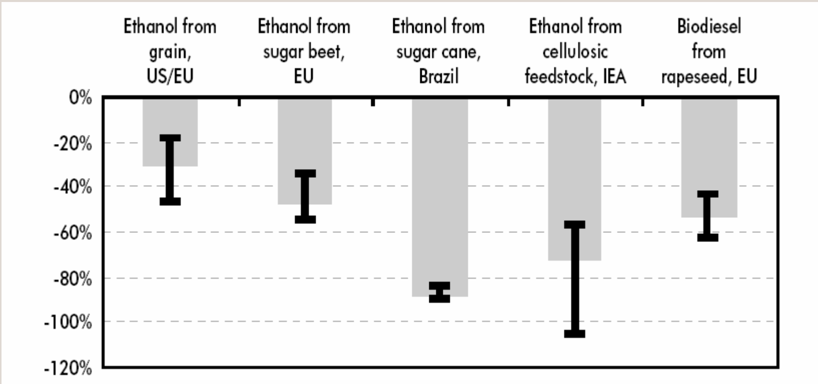






Source: World Bank

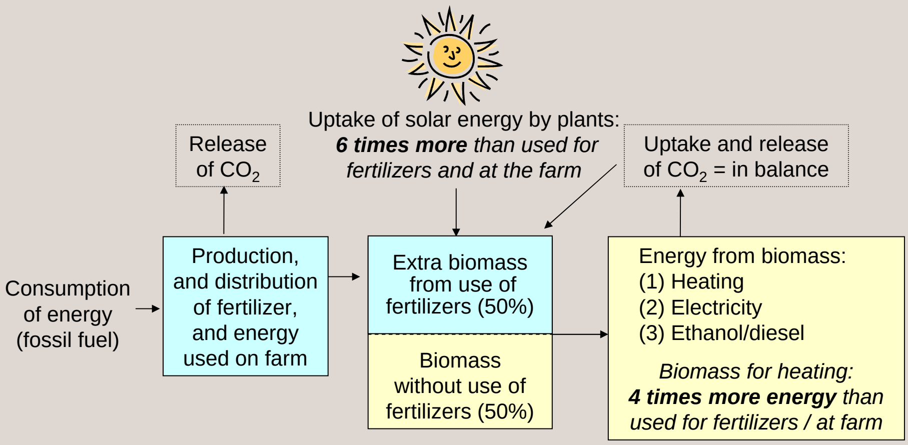
Reduction of CO_2 emission



From "well-to-wheels"

Source: IEA Biofuels for Transport

Our responsibility



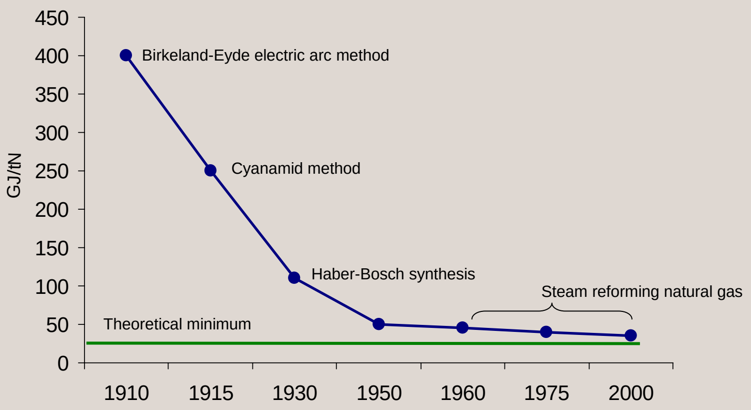
Compared to use of fossil fuel:
4 times less CO_2 emission

Our responsibility

- Energy efficient production
- Clean technology

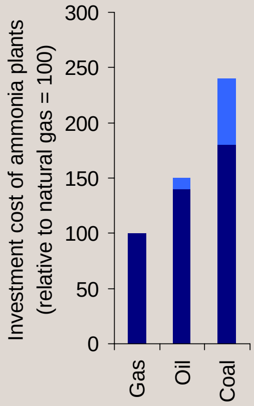
- Energy efficient distribution
- Crop specific fertilizers
- Efficient farming, with best use of fertilizers (high yield and environmental protection)

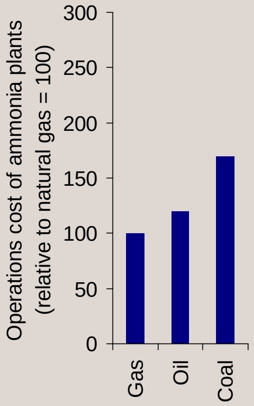
Close to minimum energy consumption / t NH_3



Investment and production cost comparisons (WE)

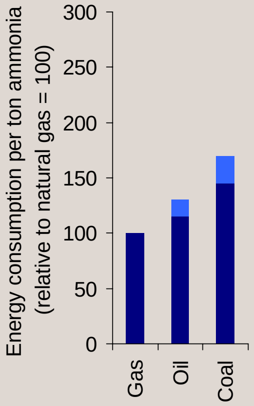
Steam reforming of natural gas is the preferred solution
Higher gas price makes coal more competitive

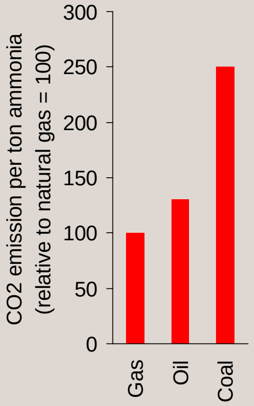




Energy consumption and CO_2 emissions

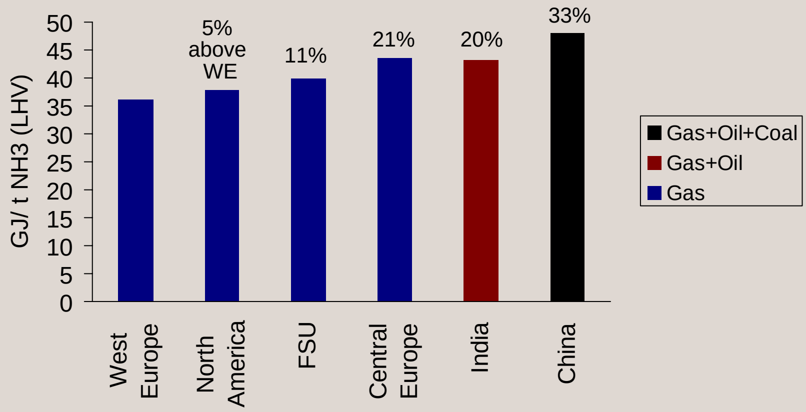
Most of the CO_2 can be captured and stored, but depends on cost





Regional variances (IEA 2003/04)

High gas cost → strong focus on efficiency (e.g. WE vs FSU)



Future

- Cost of feedstock
  → If high gas cost, shift to more coal → **more CO_2**
- Free and fair trade
  → Global price setting of feedstock?
  → If no, more production in low priced regions → **more CO_2**
- Cost of CO_2
  → Global or only European CO_2 emission trading?
  → If Europe only, more production in less regulated regions → **more CO_2**
- New developments
  → Will biomass become a feedstock?
  → Will electrolysis return?

Carbon capture and storage is discussed


Comment and analysis

Give carbon a decent burial

Most green groups are against it, but burying carbon dioxide under the sea is vital if we are to halt global warming, argue **Frederic Hauge** and **Marius Holm**

SWEEPING things under the carpet can be a bad idea. But what do you do when the floor is so thick with dust that any reduction would be an improvement? Swap dust on the floor for carbon dioxide in the air, and the carpet for the seabed, and that's a dilemma world governments now face.

In other words, as an interim measure until renewable energy replaces fossil fuels, should we start soaking up CO_2 from fossil-fuel power stations, the largest producers of CO_2, and bury it where it can't contribute to global warming? Given that the alternative means allowing climate

"If storage sites are selected carefully they could retain CO_2 over a geological timescale"

attention away from dealing with the root of the problem: our continuing dependence on fossil fuels. Green groups also worry that leaks from such burial sites could damage marine life.

Though these concerns are honourable, we are convinced they are misplaced. Tests to date indicate that there is little chance the gas would ever leak or escape. Natural hydrocarbons have stayed trapped in sedimentary basins for millions of years, and if storage sites are selected carefully they could reasonably be expected to retain CO_2 over a geological timescale. For example, in the Pisgah anticline north-east of Jackson Dome, Mississippi, 200 million tonnes of CO_2 is thought to have been trapped underground for over 65 million years.

In the North Sea, the Norwegian oil company Statoil is already burying CO_2. Natural gas from the Sleipner offshore field contains more CO_2 than is allowed in the gas distribution system, so Statoil has to separate out the excess. Instead of releasing it into the atmosphere, Statoil pumps it back offshore where it is injected into the saline Utsira aquifer 1000 metres below the seabed, under a layer of impermeable shale. Since the process began in 1996, about 1 million tonnes of CO_2 have been injected into the reservoir every year, equivalent to 3 per cent of Norway's CO_2 emissions. The alternative would also have cost Statoil dear in CO_2 emission taxes.

A seismic survey in 2002 by the British Geological Survey showed that the CO_2 was forming a bubble 1700

Technology transfer

- Industry responsibility:
  → Global standards based on BAT for new plants and revamps
- Drivers:
  → Reducing costs through greater efficiency
  → National food security strategies
  → National economic development strategies
  → Harmonisation of environmental regulations

  → **New**: Cost of CO_2 reductions
- Possible pitfalls:
  → Financing
  → Skills (content, project execution, operation and maintenance)
  → Compatibility of software and equipment

Does the regulatory framework promote efficient abatement of climate gases?

- Permitting = Old fashioned, slow and national differences
- Regulations based on economic drivers
  → Emission trading (positive)
  → Joint Implementation and Clean Development Mechanism (positive?)
  → Taxation (negative)
- Those that invest in the development and use of new technology for energy efficiency and emission reduction, should be credited. Those that are laggards, should be penalised.
- Absolutely necessary with global harmonisation of environmental regulations, especially for those emissions that have a global impact
- Emission allowances must be based on performance standards (emission per ton produced) - not slicing off a percentage on historic emissions

YARA

IFA 13.03.2007, Page: 19

Conclusions

- Several factors influence the choice of technology
- Many points to a direction leading to increase in global CO_2 emissions
- Must have international (global) regulations for emissions of global impact
- Emission trading with performance standards is fair
  → Energy consumption (= CO_2) per ton of ammonia produced
  → kg N_2O per ton of nitric acid produced
- JI and CDM can be used for technology transfer, but fair?
- More R&D (carbon capture, bioenergy)
- Lobbying is necessary to get what the industry considers the best

YARA

IFA 13.03.2007, Page: 20